Hogan Lovells US LLP
Columbia Square
555 Thirteenth Street, NW
Washington, DC 20004
T +1 202 637 5600
F +1 202 637 5910
www.hoganlovells.com

October 25, 2016

EX PARTE NOTICE VIA ECFS

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: Matters Related to Measuring Broadband America Program and Performance Measurement, GN Docket No. 12-264;
Nineteenth Annual Report on the State of Mobile Wireless Competition, WT Docket No. 16-137;
Modernizing the FCC Form 477 Data Program, WC Docket No. 11-10;
Universal Service Reform—Mobility Fund, WT Docket No. 10-208

Dear Ms. Dortch:

On October 21, 2016, Steve Berry, Rebecca Thompson, Tim Donovan, and Courtney Neville of Competitive Carriers Association ("CCA"); Grant Spellmeyer of US Cellular Corporation; Bill Poellmitz and Alberto Rubio of ClearSky Technologies, Inc. ("ClearSky") (participating by phone); and Tom Peters and Trey Hanbury of Hogan Lovells, counsel to CCA (together, the "participants"), met with Jon Wilkins, Jim Schlichting, Sue McNeil, Eliot Maenner, Margaret Wiener, Paroma Sanyal, Chris Helzer, Mark Montano, and Chaz Eberle of the Commission's Wireless Telecommunications Bureau.

The participants reviewed the attached presentation that identified concerns with the quality and reliability of the data compiled on FCC Form 477. Discussion focused on two issues.

First, while the Commission has portrayed the analysis derived from the Form 477 data as resting on a "uniform nationwide collection methodology," [1] the agency permits each carrier to choose the propagation model, loss assumptions and performance levels necessary to determine mobile broadband coverage. And even small variations in the model used or the assumptions on which the model relies can result in dramatic changes in predicted coverage. For example, a change in the model or its underlying assumptions that result in a cumulative increase of as little as 5 dB can result in a 100% increase in predicted mobile broadband coverage. The participants' initial analysis of the Form 477 data identified flaws in reported mobile broadband coverage data due to the apparent use of different models and different assumptions for inputs into those models, such as body loss.

Second, while the Commission's formatting guidelines for Form 477 indicated that carriers "should" use a common resolution of 100 meters,[2] carriers appear to have employed a wide variety of

[1] *Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, as Amended by the Broadband Data, Improvement Act*, Eleventh Broadband Progress Notice of Inquiry, 30 FCC Rcd 8823, ¶ 55 (2015).

[2] FCC Form 477, *How Should I Format My Mobile Broadband Deployment Data?*, http://bit.ly/2ewt5zo (last visited Oct. 23, 2016).

resolutions in presenting their mobile broadband coverage data to the Commission. Low-resolution images are problematic because they appear crisp at a national level, but reveal pixilation and other flaws that distort results at the state and county level where mobile broadband coverage data is most relevant. Based on a study performed by third-party analyst and CCA member ClearSky of the imagery provided on the Form 477 data by several service providers, imagery resolution of the data provided on Form 477 can vary from as low as 20 meters to as high as 972 meters. Lower resolutions (*i.e.,* larger bin sizes) tend to exaggerate coverage. For example, ClearSky's analysis showed that bin sizes of 5 to 100 meters offered relatively consistent results, but bin sizes of 500 to 1000 meters grossly overstated coverage.

As a result of these and other flaws, the Form 477 data provides an unreliable view of mobile broadband coverage, particularly in rural areas and areas of low-population density. Moreover, standard mechanisms that third parties might use to validate the data are impractical to perform because of the poor quality data. The areas ostensibly served by mobile broadband service providers cover tens of thousands of square miles and are often roadless, densely forested or otherwise difficult to access and not readily suitable for traditional methods of mobile broadband coverage verification, such as drive tests.

Permitting filers to determine their own coverage models and input assumptions as well as use of low-resolution imagery in connection with Form 477 has resulted in a lack of any common context or convention for the mobile broadband coverage data that the Commission has collected. The resulting variations and inaccuracies, in turn, raise questions about the quality, reliability and utility of the Form 477 data.

Pursuant to section 1.1206(b) of the Commission’s rules, we have filed this letter electronically. Please direct any questions regarding this submission to me.

Respectfully submitted,

/s/ Trey Hanbury

Trey Hanbury
Partner
trey.hanbury@hoganlovells.com
D 202 637 5534

Form 477 Data Quality, Reliability, Reproducibility and Utility Concerns

October 21, 2016

FCC Form 477 Data Quality

- The FCC's Form 477 data will have a clear and substantial impact on important public policies and private sector investment decisions
- The FCC is contemplating the elimination of universal service support for areas deemed served by one wireless LTE operator
- The FCC's definition of LTE coverage does not rest on a common set of assumptions or models
- Even small variations in the assumptions used in self-reported propagation and loss models can alter reported coverage by 100% or more
- The public cannot replicate the carriers' coverage models without additional data, much of which may have competitive effects
- The public cannot drive test coverage claims because even small changes can increase predicted coverage by hundreds of thousands of square miles, and much of the increased coverage will typically involve land that is roadless, densely forested, wetland or otherwise difficult to access and not readily suitable for traditional methods of coverage verification

Reliance on Form 477 Data Poses an Imminent Threat of Harm

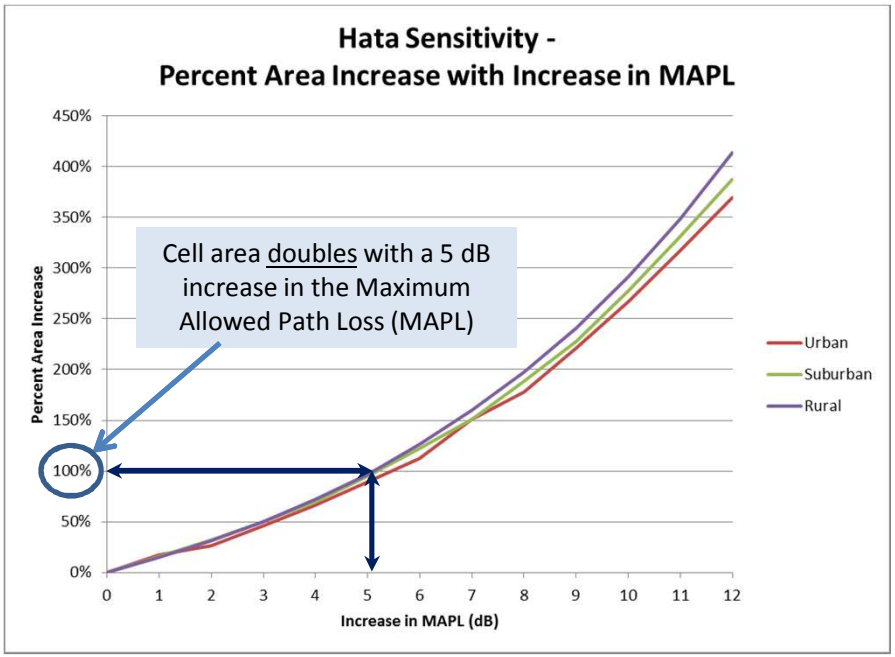
- The available Form 477 data reveal inconsistencies in reporting that undermine the reliability, accuracy and reproducibility of the data the FCC is using to make its substantive determinations for public policy
  - AT&T presents one LTE coverage model to customers, another to the FCC; one or both may misrepresent "actual" coverage
  - Verizon uses a different modeling technique than AT&T; Verizon's model does not exhibit the coverage bloat seen in AT&T's model
- The FCC has not:
  - Specified a common means of creating the models;
  - Provided transparency to the operators' methodological tools and assumptions;
  - Validated the predictive models that carriers are self reporting; or
  - Performed robustness checks through its own independent analyses.

Form 477 Data Lack Substantive Objectivity and Reproducibility

- Carriers can alter link budget variables to increase or decrease coverage results as needed to alter predicated coverage
- Propagation model variables for which minor changes can result in markedly different coverage predictions include:
  - Fade margin
  - Shadowing factor
  - Cell edge reliability factor
  - Hand & body losses
  - Penetration losses
- The values of these variables will determine the coverage level threshold (e.g., minimum RSRP for LTE), and the Maximum Allowable Path Loss (MAPL)
- In addition, different empirical propagation models give different results and include additional inputs such as clutter and terrain losses
- While the precise mix of variables and effects will vary depending on the model, <u>all</u> propagation models are highly sensitive to changes to input variables

Propagation Models are Very Sensitive to Link Budget Changes

- *Assumes Hata formulas at 752 MHz using a baseline MAPL of 130 dB*
- *Results are similar for other values of baseline MAPL*

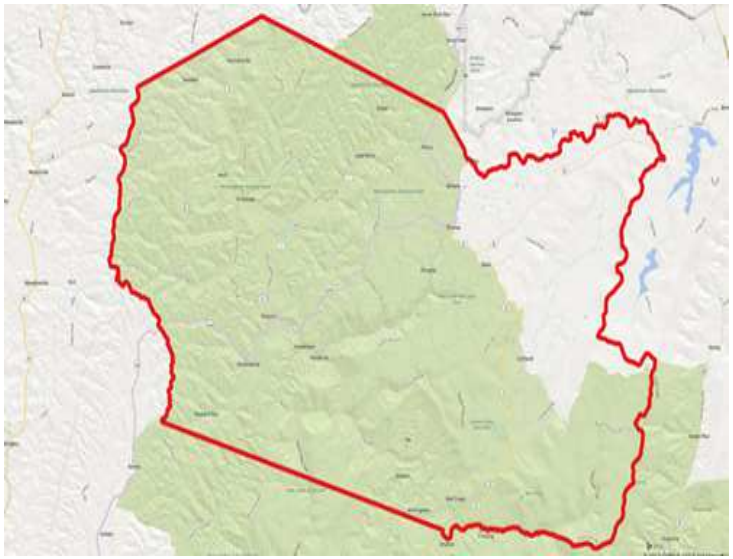


The Resolution of the Submitted Coverage Data is Also Critical

- The definition of coverage is highly sensitive to the resolution used to produce the data
- Higher resolution data, or data produced using small bin sizes, results in more accurate depictions of coverage
- Using low resolution data (e.g., 500 – 1000 meter bins) can grossly overstate coverage
- The bin size used by AT&T and Verizon for their Form 477 shapefiles exceeds 500 meters, which further distorts their stated coverage
- ClearSky performed an example analysis using Tucker County, WV as an example

Example: Tucker County WV

Tucker County, WV



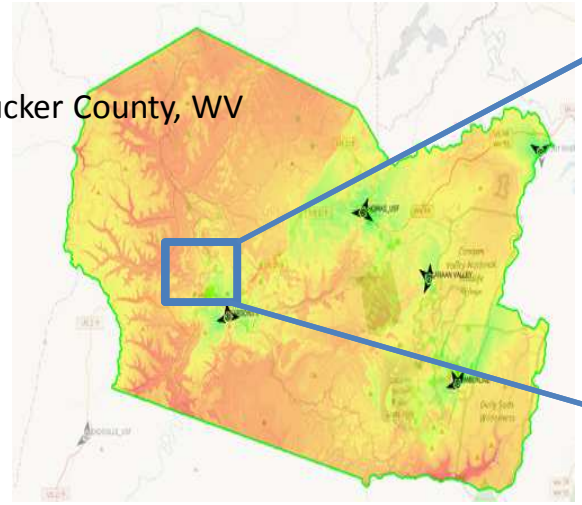
Problem Statement

- How much of the population is covered by operator X?
- How to determine population or populated areas that should be covered?
- What constitutes coverage?
- Can a modeling vs. drive test approach be used?
- What resolution of a modeling approach is appropriate?

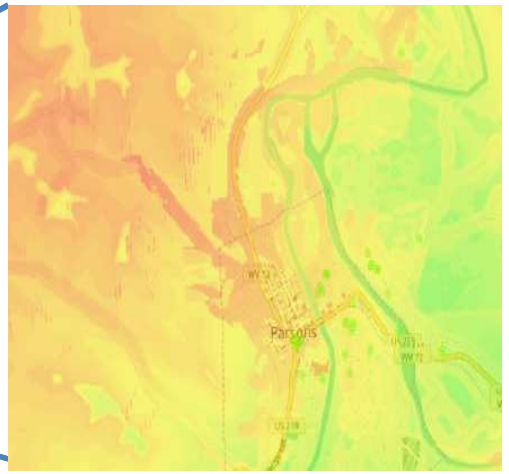
Operator X LTE Coverage in Tucker County

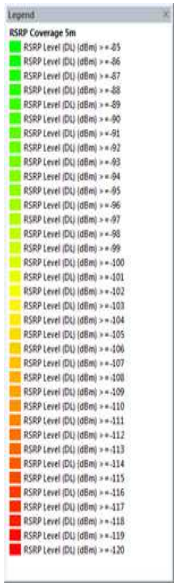
- Realistic approach
- Fast
- Reliable
- Accurate

Tucker County, WV



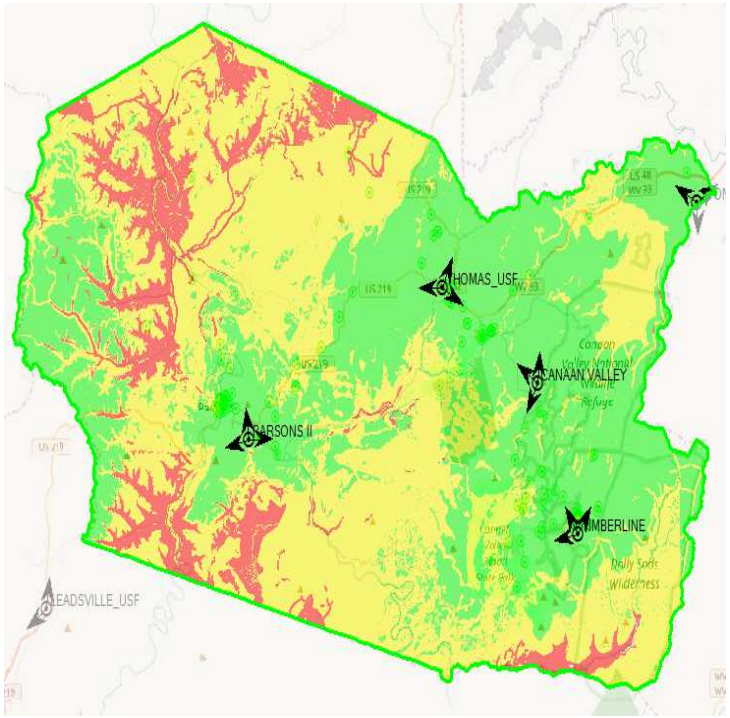
Zoom In

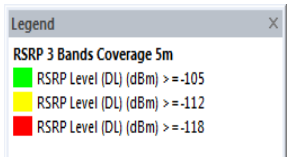




What Is Considered Covered?

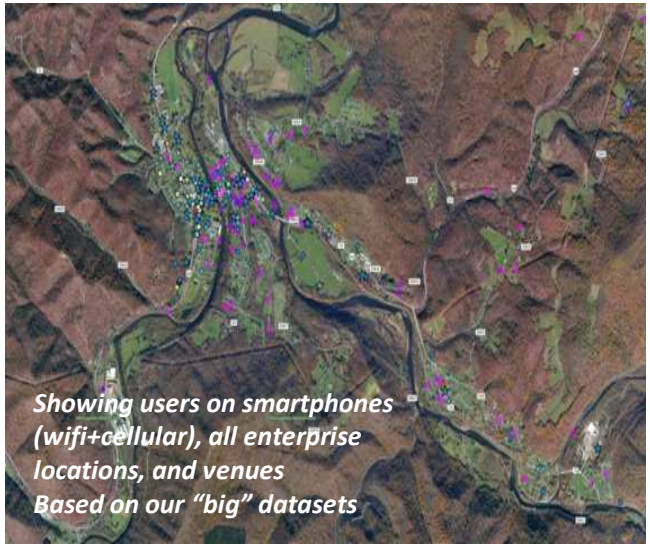
- LTE prediction colors are based on vendor link budget
- Link budget provided dictates Downlink RSRP (dBm) based on an Uplink data rate target
- The lowest data rate corresponds with -120dBm DL RSRP
- DL RSRP lower than the specified value of -120 technically is still within the range of the receiver sensitivity but is not practically useful





Good LTE Coverage
Fair LTE Coverage
Poor LTE Coverage
No Coverage

Where Should I Be Covering? Using Proxies



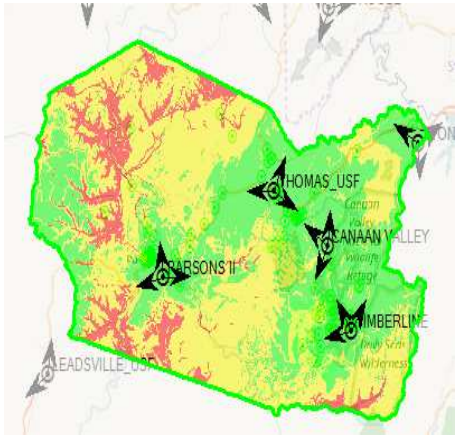
- If locations where population spends a significant amount of time should be covered then proxies can be used to represent
  - Work locations
  - House locations
  - Touristic locations
  - Recreational locations

- If 911 calls are required inside vehicles then all roads should be a criteria

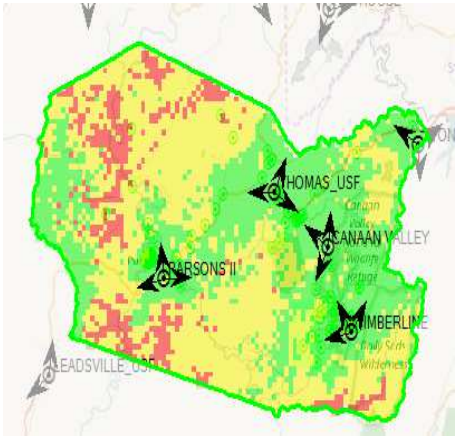
Analysis Resolution Testing

- An identical analysis of good, fair, poor, no coverage was performed in Tucker county and only resolution was changed
- Resolutions of 5m, 10m, 30m, 100m, 500m, and 1000m were evaluated

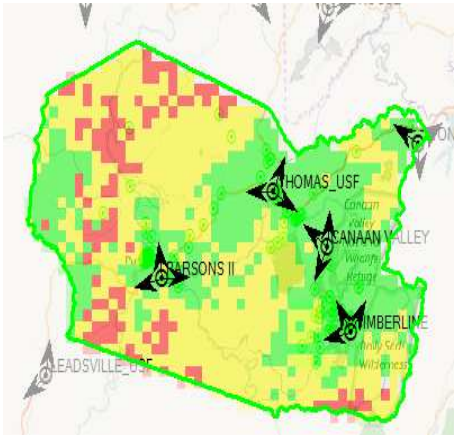
5m



500m



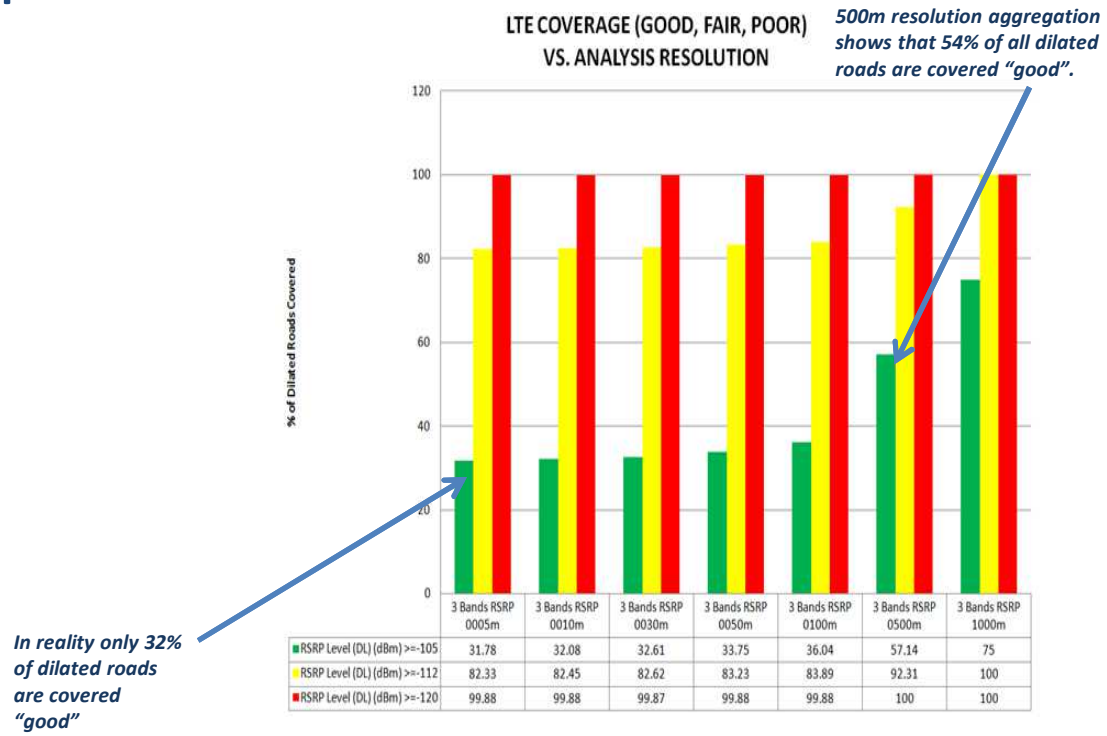
1000m



Good LTE Coverage
Fair LTE Coverage
Poor LTE Coverage
No Coverage

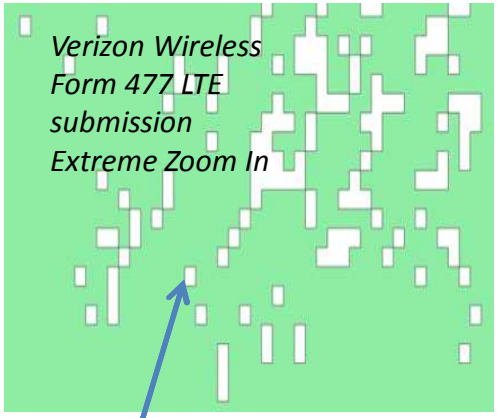
The Importance Of Resolution

- The Cumulative Distribution Function chart (CDF) shows the cumulative percentage of roads covered at good, fair, or poor coverage at multiple resolutions
- The averaging at poor resolution leads to inaccurate statistical reporting of area/ percentage of dilated roads covered
- Inaccuracy manifests itself in drastically optimistic reporting



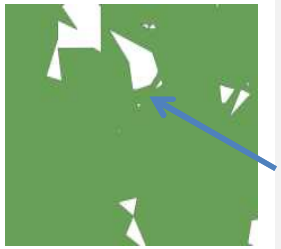
Map Resolution for Form 477 Submissions

Extreme Zoom In



734mx972m

An extreme zoom in allows us to see individual pixels. These pixels can be measured which tells us the resolution of the base raster map used that was converted to this vector map and submitted with Form 477



Inconclusive results for Sprint as they used an unusual smoothing method which renders the pixels as irregular triangles

Sample of resolution sizes submitted

Operator	x (meters)	y (meters)
Verizon Wireless LTE	734	972
ATT Mobility	675	675
T-Mobile LTE	300	188
Sprint LTE	~100	~100
Ntelos LTE	40	30
Carolina West LTE	20	20

Note inconsistencies in pixel sizes in individual maps due to mapping projections that were used.

Flaws in the Form 477 Data Extend Beyond Uncertain Modeling

- Permitting self-defined models causes coverage assessments to vary among carriers and over time
- Uncertainties about propagation models are typically overcome by convention, common context and transparent methodologies – none of which are present here
  - The common assumptions and techniques necessary to allow for meaningful comparisons are not defined
  - The assumptions and methodologies used by each carrier are unknown to the public
  - The data has been developed outside of any well understood context or research criteria

Backup Slides

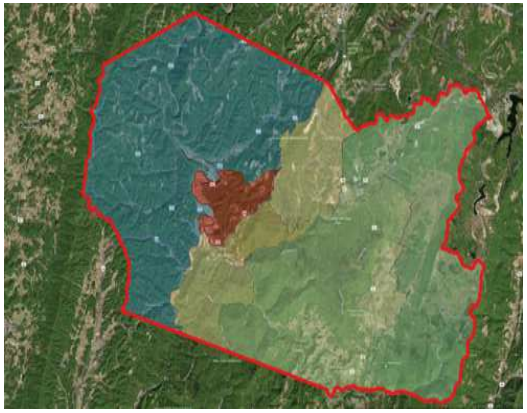
Data Analytics

- Data analytics can be used to report on many attributes of Operator X performance within the county
- Slicing and dicing data can be used as a helpful reporting tool

	TOTPOP_CY	MEDHINC_CY	AREA	AREAKM	DATAsum	ENT_COUNT	DATADEN	ROADAREAKM	RDAREAKMDI	RSRP	SINR	FID	POPDENSITY	POPPCNT	DATAPCNT	RSRPmean	SINRmean	RSRPPCNT	SINRPCNT
0	4659	15279	151766703.2934...	151.8	317459.0000000...	18	2091.3	4.7	24.7	-104	6	0	30.7	0.0	0.0	19.16859267498...	4.985314643038...	0.7	
1	450	16081	822387.074707	0.8	130452.0000000...	78	163065.0	0.2	0.6	-93	7	1	562.5	0.4	1.0	8.392124119504...	3.090842846733...	0.3	
2	702	25076	633611.545410	0.6	73286.00000000...	14	122143.3	0.1	0.4	-97	6	2	1170.0	0.9	0.7	12.38378890820...	4.369134144414...	0.5	
3	849	19787	208779654.9174...	208.8	74215.00000000...	14	355.4	4.7	25.5	-108	5	3	4.1	0.0	0.0	23.13786152514...	5.750729241057...	0.9	
4	723	25322	59921698.586182	59.9	132178.0000000...	22	2206.6	1.6	8.4	-108	0	4	12.1	0.0	0.0	23.01924915085...	10.52558312407...	0.9	
5	155	17703	53245037.426270	53.2	16986.00000000...	2	319.3	1.5	8.5	-107	6	5	2.9	0.0	0.0	22.05167172824...	4.899016890070...	0.8	
6	1175	29581	302751208.6579...	302.8	310384.0000000...	36	1025.0	8.4	45.6	-105	-1	6	3.9	0.0	0.0	20.96399532450...	11.30190714994...	0.8	
7	1171	17509	2749422.142334	2.7	171362.0000000...	98	63467.4	0.3	1.2	-93	7	7	433.7	0.3	0.4	8.649883170135...	3.408222640445...	0.3	
8	946	26041	908186.283691	0.9	134914.0000000...	34	149904.4	0.1	0.5	-101	3	8	1051.1	0.8	0.9	16.37718960008...	7.340255591054...	0.6	
9	1246	21558	154529387.527588	154.5	399519.0000000...	64	2585.9	4.9	25.4	-105	2	9	8.1	0.0	0.0	20.45477708098...	8.429540844151...	0.8	
	[illegible]	14951	2913947.265686	2.9	39143.00000000...	144	[illegible]13457.6	0.3	[illegible]	-91	[illegible]	10	322.4	0.2	0.1	6.[illegible]5767570...	1.518744154567...	0.2	

Table View showing census tract with data aggregated by tract detailing

- **Population density**
- **Median income**
- **Count of enterprise locations**
- **Aggregate LTE coverage level**
- **Aggregate LTE SINR**
- **Data Demand Density**
- **Number of high target locations to cover**
- **…..any combination of the above**

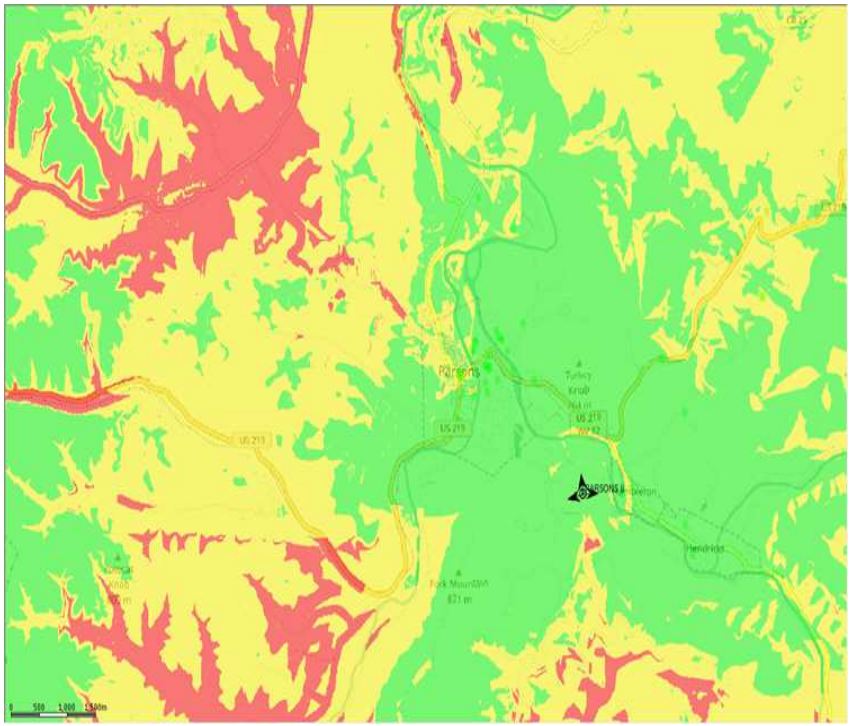


Map View
Tucker county by census tract showing aggregated real world data demand on smart phones

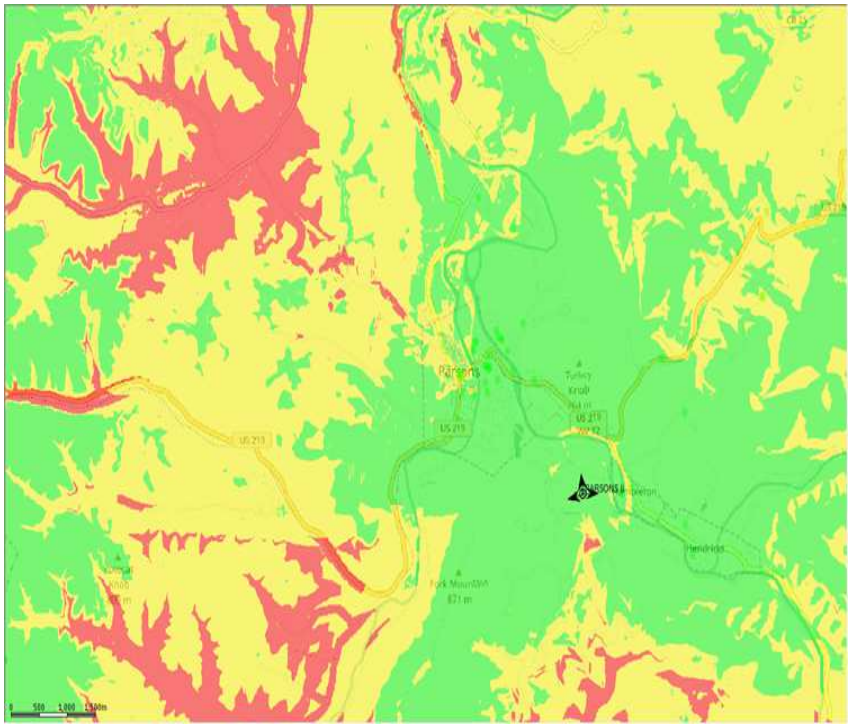
How The Simulations Were Made

- ClearSky generated land use obstructions (i.e. trees, grass, roads, water, etc) using new satellite imagery extraction technology.
- Typically wireless operators use generic land use categories (i.e. urban, suburban, etc) which would not be applicable for this analysis
- To create the dilated roads we built upon our extraction of roads and increased the physical road dimension by 105m surrounding the road
- Propagation models that work with our obstruction based clutter classes used. These models run very quickly even at 5m resolution
- Other proxies such as all enterprise locations, venues, smartphone data usage, smartphone usage by OS type (iPhone, Android, etc.) were all collected and processed using our ClearSky NetView360 big data and analytics engine
- Data aggregation and analytics were performed using our NetView360 analytics engine

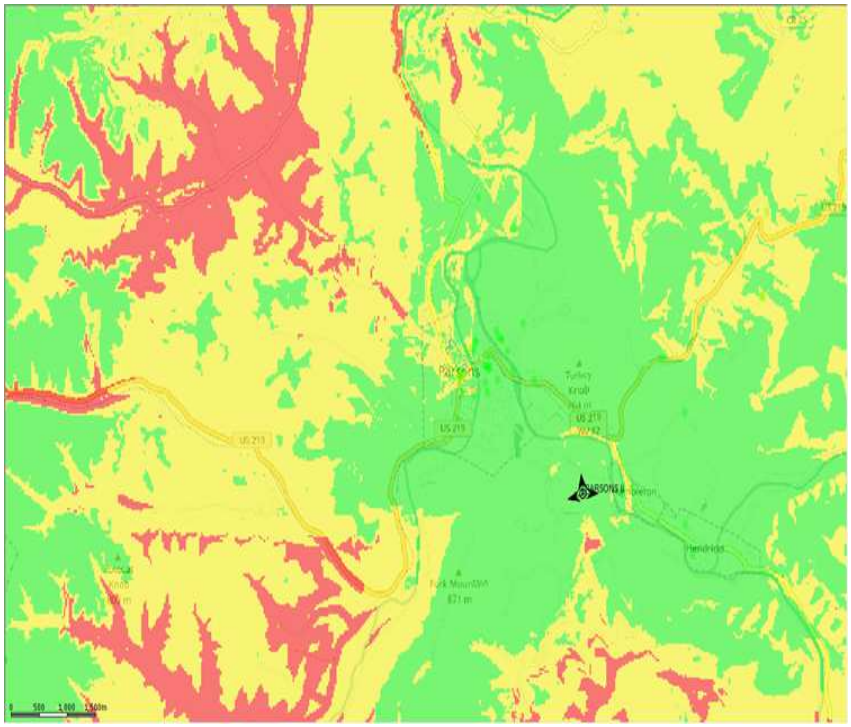
Zoom of 5m Resolution RSRP Plot



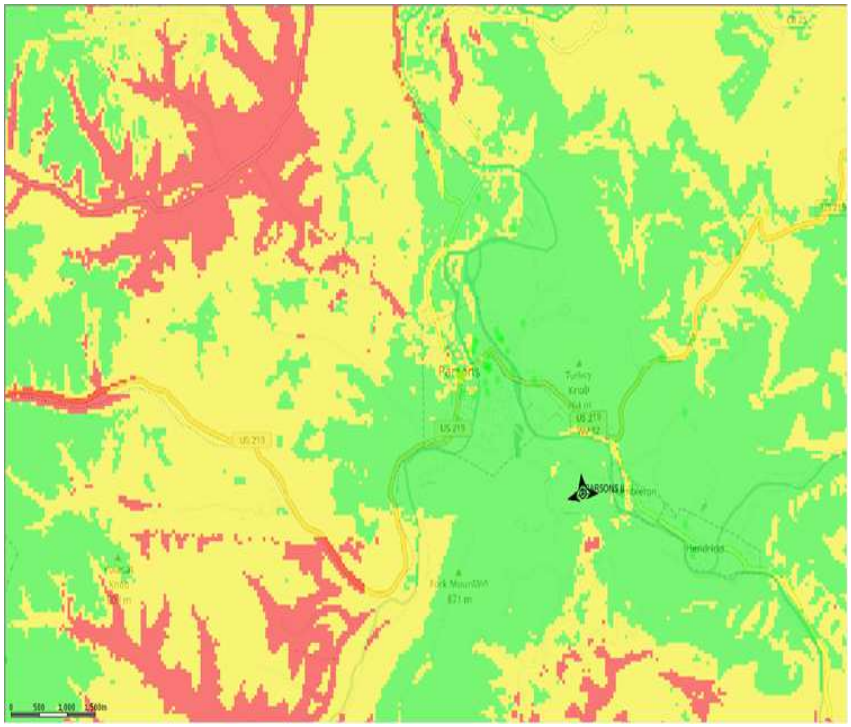
Zoom of 10m Resolution RSRP Plot



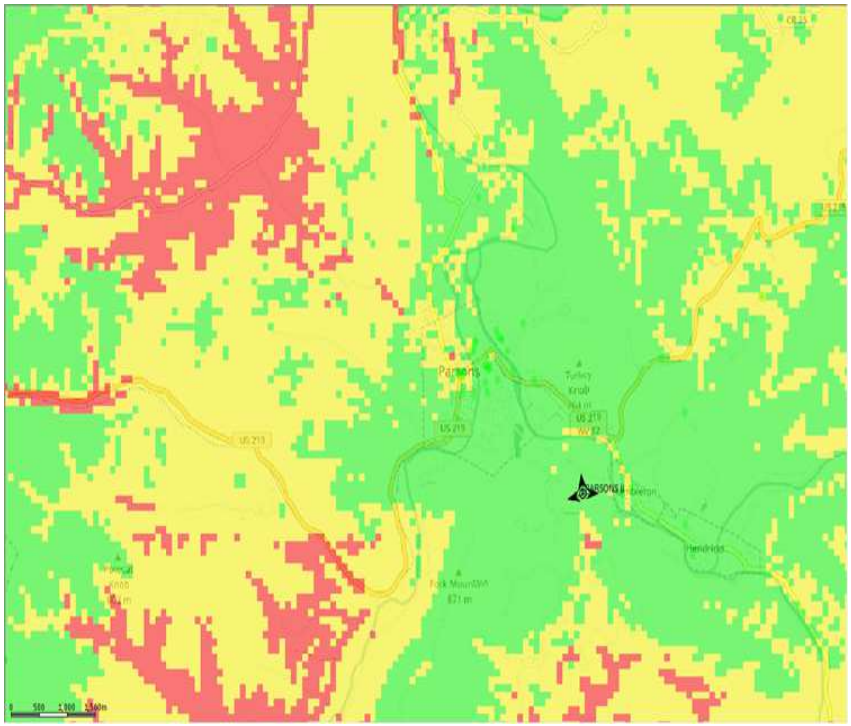
Zoom of 30m Resolution RSRP Plot



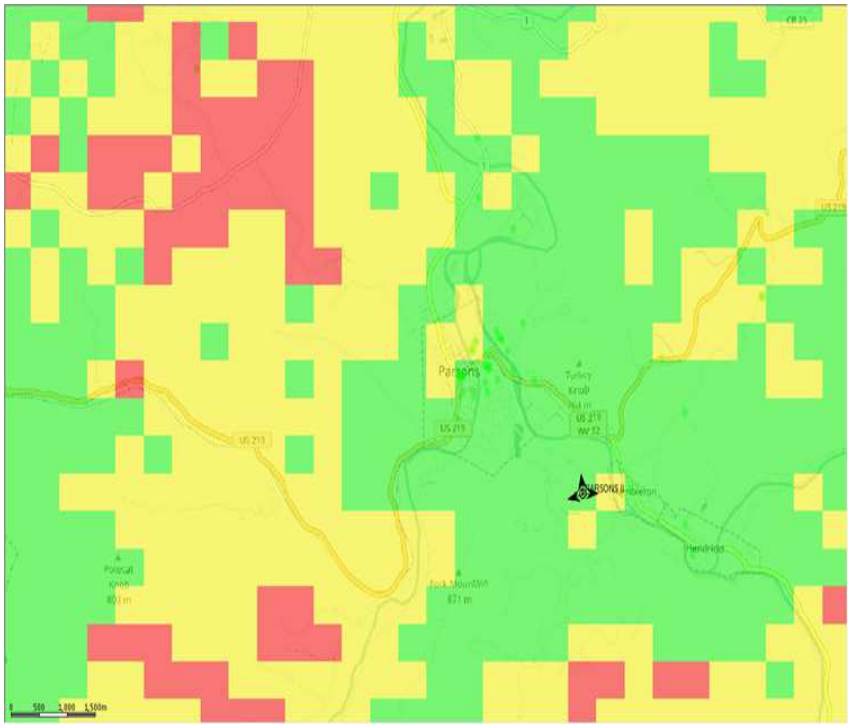
Zoom of 50m Resolution RSRP Plot



Zoom of 100m Resolution RSRP Plot



Zoom of 500m Resolution RSRP Plot



Zoom of 1000m Resolution RSRP Plot